CALIBRATION PROCEDURES

BEHLMAN ENGINEERING

KB SERIES POWER SUPPLIES

USING MOTHER BOARD 15-076

Behlman
Engineering Corporation

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1.0 GENERAL INTRODUCTION

Behlman Engineering Power Supplies come in many different configurations and ratings. The customers needs determine the size of the unit, which means the number of chassis required may vary. Since the physical arrangements differ, it may be beneficial for the technician to become familiar with the layout of the power supply and the location of the following components, as they will be referred to by name throughout this discussion.

1) Mother board and associated cards:
   a) Voltage card
   b) Measurement card
   c) Frequency card
2) Driver card(s), one for each phase, sometimes located in different chassis.
3) Power output stage transistor stacks, one stack for each phase.
4) Primary and secondary regulation capacitors.

The drawings provided give a pictorial representation of the location and/or shape of the above parts.

This discussion only covers the calibration of one phase, generally A phase. If the unit has more than one phase, the calibration procedure must be repeated for each phase.

Please read Appendix A before attempting to work with units as they can generate voltages and currents that are hazardous to humans as well as the internal circuitry of the unit.

2.0 EQUIPMENT NEEDED

1) Calibrated multi-meter with following ranges:
   a) 0-20 VDC.
   b) 0-20 VAC.
   c) 0-300 VAC.
   d) 0-10 AC amps.
2) Calibrated oscilloscope.
3) Calibrated frequency counter.
4) S-100 bus extender card.
5) Appropriate load for unit under test: See Appendix B for load calculation and cautions.
6) #1 phillips and a small flat blade screw drivers.
7) One or two small clip leads.
8) Signal generator: Sine wave, 400 Hz, 0-10 VAC.

3.0 CALIBRATION

The power supplies consist of two main parts: First, the power amplifier, which encompasses the Driver card, the power output transistor stacks, and the output transformer, and, second, the oscillator/control section which consists of the Mother Board and its associated boards. The amplifier must be calibrated first.

3.1 AMPLIFIER CALIBRATION

A. Offset null adjustment

1) Turn off power and discharge primary and secondary +60V regulation capacitors.
2) Remove the Voltage card from the Mother Board and set it aside.
3) Using a small clip lead, jumper test points 1 to 2 on driver card.
4) Connect a DC voltmeter from test points 3 to 2. Turn both potentometers on Driver fully counter-clockwise.
5) Replace Driver card and turn on power supply.
6) The voltage must be 0.000 $\pm$ .010 VDC.
   a) If the voltage is too negative shunt R34 to bring value into specification.
   b) If the voltage is too positive shunt R33 to adjust.
7) Remove jumper and meter.

B. Positive feedback (regulation) calibration

1) Connect a signal generator from test points 1 to 2 (gnd), on the Driver card. Replace Driver into socket. Make sure Voltage card is removed. Set 400 Hz and 0 Volts on signal generator.
2) Connect an AC voltmeter to the output terminals of the unit, NEUTRAL to HOT.
3) Turn on power supply.
4) Turn on OUTPUT switch.
5) Adjust output of signal/generator until meter reads 100.0 VAC.
6) Turn off OUTPUT switch and connect an appropriate load to output terminals.
7) Turn on OUTPUT switch.
8) Adjust R11 on the Driver card until the output voltage reads 100.0 $\pm$0.3 VAC.
9) Turn off OUTPUT switch, turn off power and disconnect test equipment.

C. Overload Calibration

1) Replace the Voltage card in its socket. Make sure it is seated fully in its socket.
2) Connect an ammeter in series with the load and connect the load to the output terminals. Connect an oscilloscope across the output and adjust for 50V/cm.
3) Turn on the unit. Program 100V into the unit and turn on the OUTPUT switch.
4) Increment the voltage slowly until the ammeter reads 1.22 times the unit's rated current.
5) Adjust R14 on the Driver card until the output waveform just clips.
6) Program 0V. Repeat steps 3-5 until the set-point is at 1.22 times rated current, $\pm$3%.

3.2 OSCILLATOR CALIBRATION; DIGITAL CONTROL

A. Warm up unit.

1) Temporarily replace top cover of unit.
2) Turn on unit and allow to stand for 10 minutes to reach a stable temperature.
3) Do not turn off LINE switch during procedure unless instructed to do so.

B. Voltage calibration:

1) Turn off OUTPUT switch and disconnect any load from the output. Program 0V on the unit. Set RANGE switch, if installed, to the low, 0-135, range.
2) Connect an oscilloscope and AC Voltmeter across the output terminals and turn on the OUTPUT switch.
3) Locate Voltage card. Adjust potentiometer RZV of phase being calibrated, clockwise, until the voltage reaches about 3VAC.
4) Back off RZV, counter-clockwise, until the voltage just stops dropping. Note that as the pot is adjusted more counter-clockwise the voltage will drop momentarily but return to the stable value. Open the pot clockwise and readjust counter-clockwise to just the stable point.
5) Do this step if the unit has a RANGE select switch;
   a) Put unit in low range, 0-135VAC
   b) Program 100VAC
   c) Turn RANGE select switch to the high range. Note that the voltage goes to nearly zero.
   d) Adjust RZV clockwise until the voltage drops rapidly to zero.
   e) Return RANGE select switch to low range.
6) Without a load, program full range voltage, generally 134.9VAC. Observe the output. Make sure the signal does not clip on either top or bottom. If any clipping is observed adjust RDC of phase until the clipping no longer occurs. Note, if at anytime during the calibration of the oscillator clipping of one part the signal is observed, adjust RDC until the clipping is cleared.
7) Program 100V, adjust RAD until the voltmeter reads 100.0VAC.

C. Measurement calibration

1) Locate Measurement card. Leave unit on and unloaded.
2) Using a short clip lead, short TP1 to ground.
3) Adjust RZM until the readings on the display for voltage and current just flicker between 0.0 and 0.1.
4) Program 100V. Connect a voltmeter across the output. Make sure no load is connected. Remove clip lead from TP1 and ground. Turn on the OUTPUT switch.

5) Adjust RV of the phase being calibrated until the display reads the same as the voltmeter.
6) Turn off OUTPUT switch. Program OV. Connect an A.C. Ammeter in series with the load and connect the load to the output. Turn on OUTPUT switch.
7) Increase the voltage slowly until the current reading on the meter is just below 10 AC Amperes.
8) Adjust RI until the display shows the same reading as the meter.

Note: There is often a ± 1 digit flicker in the displayed reading. Adjust readings until the flicker is above and below measured value.

D. Frequency Calibration

1) Turn off LINE switch.
2) Place Frequency card on extender card.
3) Connect a frequency counter from U19/1, ground, to U19/3.
4) Turn on LINE switch.
5) Adjust C34 until the frequency reads 18.000000MHz. While adjusting C34, make correction then remove adjusting tool and take reading to eliminate capacitive effect of hand and tool.
6) Turn off power supply.
7) Replace Frequency card in its socket making sure it is seated fully.
8) Turn on LINE switch.

Reassemble the cards and card restraint and test unit to make sure it is working properly. Replace the top cover to complete the calibration.

APPENDIX A: Notes on Caution

These power supplies are capable of generating currents and voltages that can be hazardous to humans or equipment. Do not place hands or tools inside the chassis when power is applied to the unit except to adjust the potentiometers that are accessable from the top. Especially avoid such items as capacitors, transformers, and transistor stacks.

All of the plug-in type boards use relatively low power. If it is necessary to work on a specific board it is not dangerous to work on it with the power on, while it is on an extender card, as long as reasonable care is used by the operator.

Do not remove any board, component, or place hands or tools inside the chassis until the power is off and the primary and secondary filter capacitors for the +60VDC supply have been discharged. This discharge can be accomplished by shorting the terminals of the capacitors with a 25 Ohm, 25W resistor. Care must be taken to avoid overheating of any shorting device!

It is best to strap the NEUTRAL output terminal to the GROUND TERMINAL to avoid unwanted ground paths through test equipment.

APPENDIX B: Load requirements

The Behlman Engineering Power Supplies have many configurations, each one with a different maximum output requirement, While performing tests and calibrating these units it is necessary to have available a load that is capable of stressing the equipment.

These loads are generally large power resistors configurated as to handle the power requirements and provide the necessary resistance. Behlman Engineering uses large banks of wire wound resistors, configured in the proper way for the unit being tested. Each resistor in the bank is rated at 175 Watts or more and the total assembly is cooled by fan to prevent overheating of the resistors.

Calculating load values

Most full power tests are done with the nominal output voltage at 100 VAC. To test the unit properly a load capable of drawing full rated power is necessary, when the voltage is at 100 VAC. If the unit is a multiphase unit, a load for each phase is required.

Calculating the required load is simply a matter of dividing the maximun output power per phase by the test voltage, generally 100 VAC. Dividing the test voltage , 100 VAC, by this product gives the total resistance needed.

EXAMPLE

Unit rated at 750 Volt-Amperes per phase.

750VA / 100 Vac = 7.5 amperes.

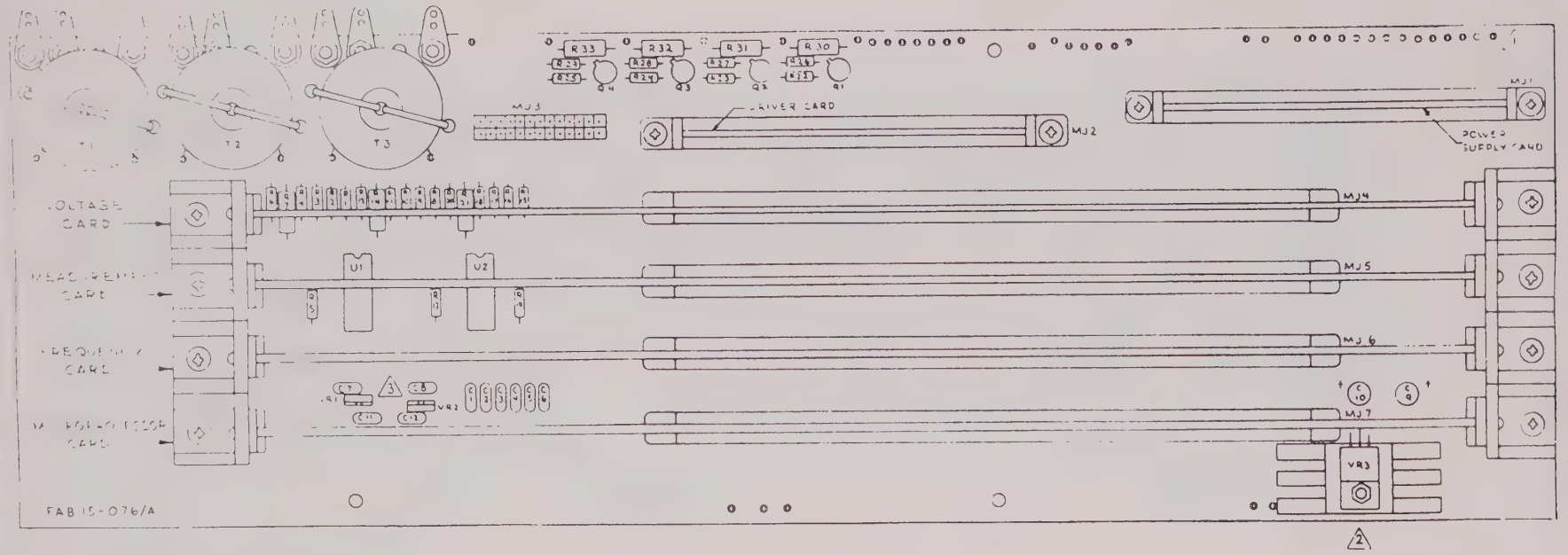
and

100 Vac / 7.5 amperes = 13.33 ohms.

To properly conduct certain tests this load must be able to disapate 1.50 times the rated power with no damage.

NOTES

COMPONENT LAYOUTS

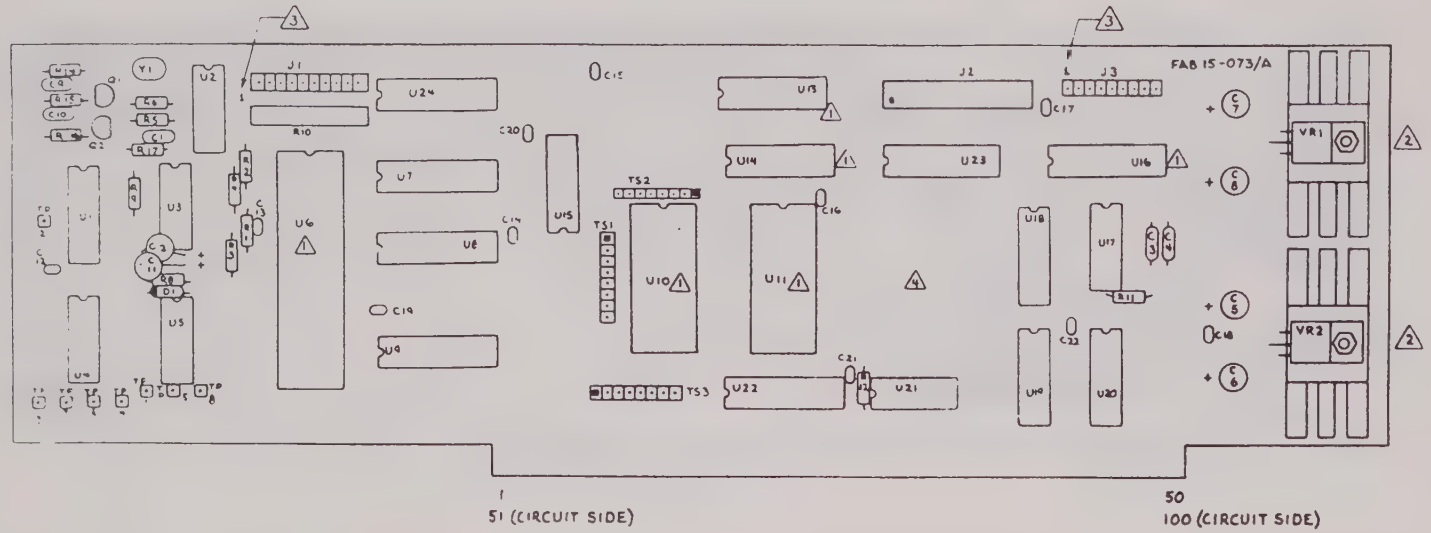


NOTES

1. BIFURCATED TERMINALS (47 PLACES)
2. INSTALL 6070B HEAT SINK WITH COMPOUND FOR VR3; INSTALL MOUNTING SCREW FROM CIRCUIT SIDE
3. MOUNT VR1 & VR2 VERTICALLY, LEADS STRAIGHT.

BOTTOMPLATE	
NEXT ASSY	USED ON
APPLICATION	

Behlman Engineering Corp SANTA BARBARA, CALIFORNIA	
DRAWN BY RK	APPROVED BY
DATE 12-28-83	SCHEMATIC: C-1004
TITLE 3 PHASE MOTHER BOARD	
ASSY NO. 16-149	DRAWING NO B-2102 REV



NOTES:

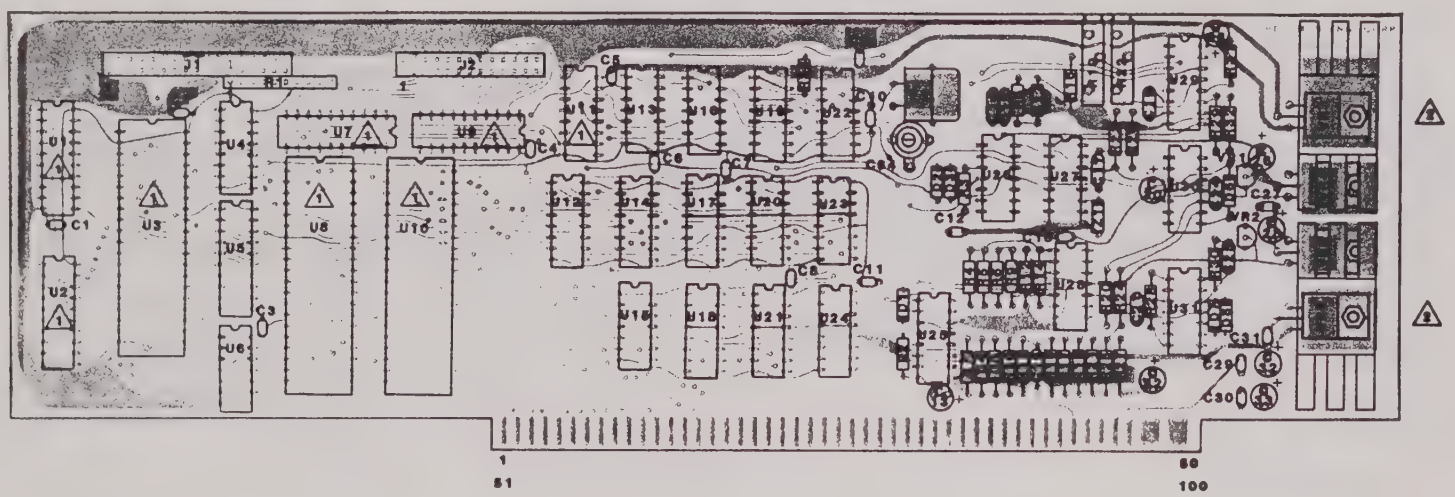
1. SOCKETS REQUIRED.
2. INSTALL 60708 HEATSINK WITH COMPOUND
   INSTALL MOUNTING SCREW FROM CIRCUIT SIDE.
3. TRANSFER NUMBER "1" (BLACK) AT THIS LOCATION.
4. PROVISION FOR U12 WHEN REQUIRED.

16-149 OR 16-190	
NEXT ASSY	USED ON
APPLICATION	

Behlman Engineering Corp
SANTA BARBARA, CALIFORNIA

DRAWN BY RK	APPROVED BY
DATE 12-20-83	SCHEMATIC: B-1878
TITLE MICROPROCESSOR CARD	
ASSY NO. 16-141	DRAWING NO B-2100 REV

SCARAB GRAPHICS NO 83748



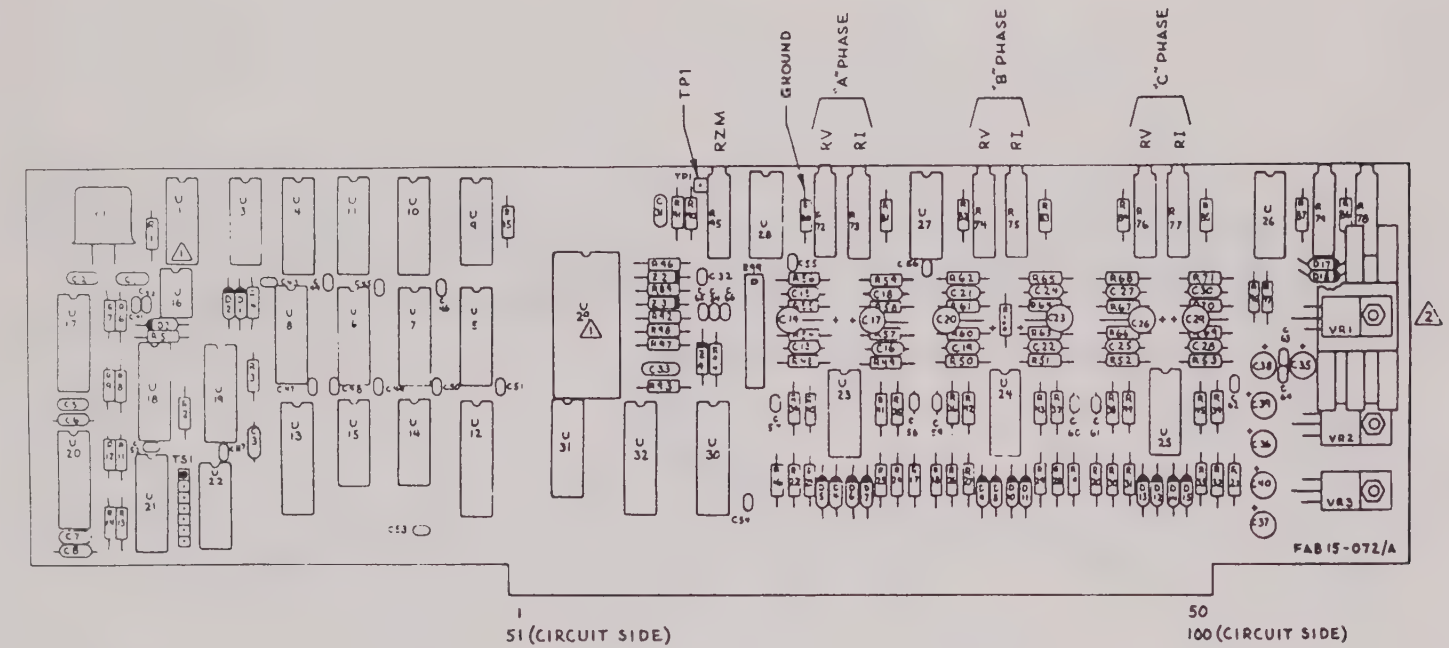
NOTES:

1. SOCKETS REQUIRED.

2. INSTALL 6070B HEAT SINK WITH COMPOUND.

Behlman Engineering Corp SANTA BARBARA, CALIFORNIA	
DRAWN BY P.L.KOCH	APPROVED BY
DATE 3-2-84	SCHEM. B-2075
TITLE DIGITAL FREQUENCY CARD	
MODEL ASSY 16-194	DRAWING NO. B-2076

BISHOP GRAPHICS/ACCUPRESS
ORDER NO. A11215



NOTES:

⚠1 SOCKETS REQUIRED.

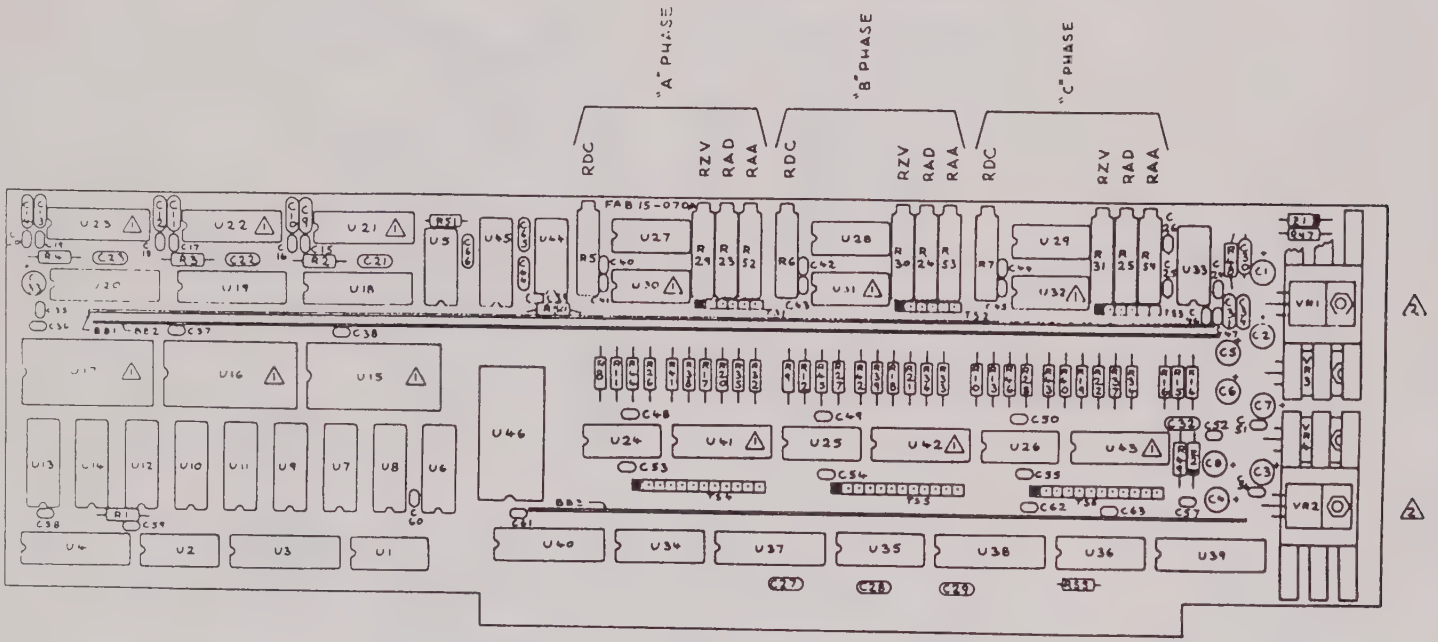
⚠2 INSTALL 6070B HEAT SINK WITH COMPOUND ON VR1 ONLY; INSTALL MOUNTING SCREWS FROM CIRCUIT SIDE.

16-149	
NEXT ASSY	USED ON
APPLICATION	

Behlman Engineering Corp
SANTA BARBARA, CALIFORNIA

DRAWN BY RK	APPROVED BY
DATE 12-29-83	SCHEMATIC: B-1866
TITLE 3 PHASE MEASUREMENT CARD	
ASSY NO. 16-140	DRAWING NO B-2099 REV

SCARAB GRAPHICS NO 83748



NOTES:

1. SOCKETS REQUIRED.
2. INSTALL 6070B HEATSINK WITH COMPOUND. INSTALL MOUNTING SCREW FROM CIRCUIT SIDE.

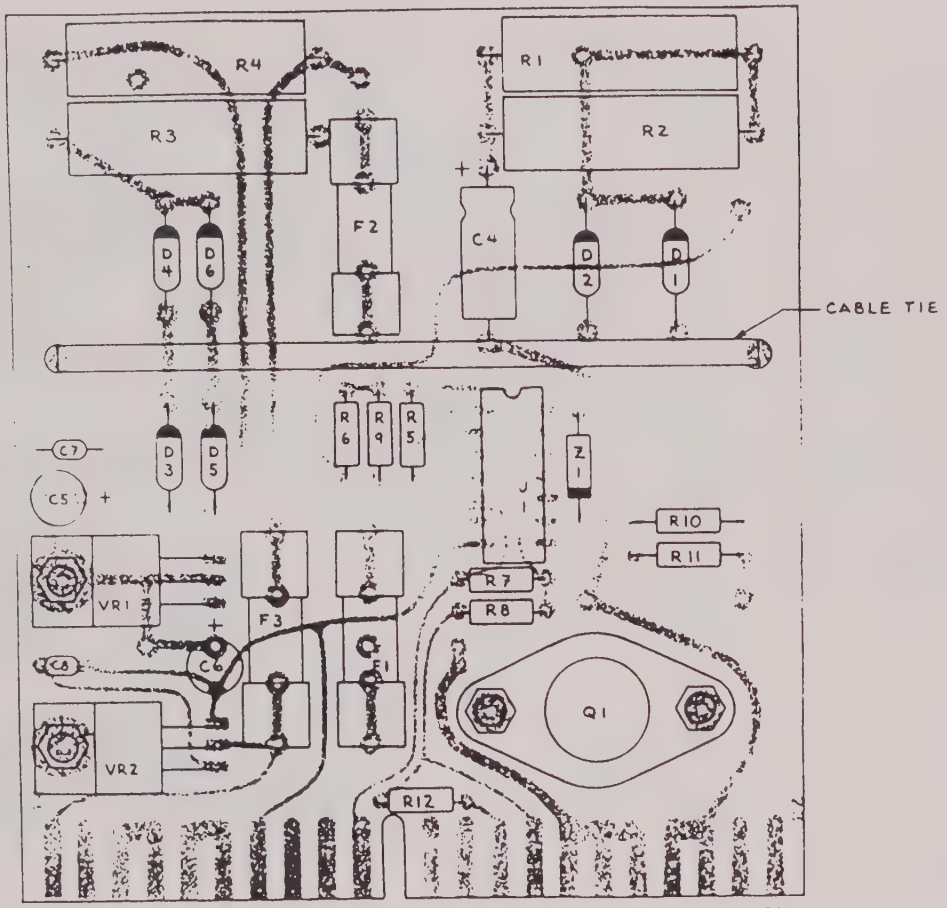
16-149	
NEXT ASSY	USED ON
APPLICATION	

Behlman Engineering Corp
SANTA BARBARA, CALIFORNIA

DRAWN BY WH	APPROVED BY
DATE 11-11-83	SCHEMATICS B-1859
TITLE 3 PHASE KB VOLTAGE CARD	
ASSY NO. 16-138	DRAWING NO B-2098

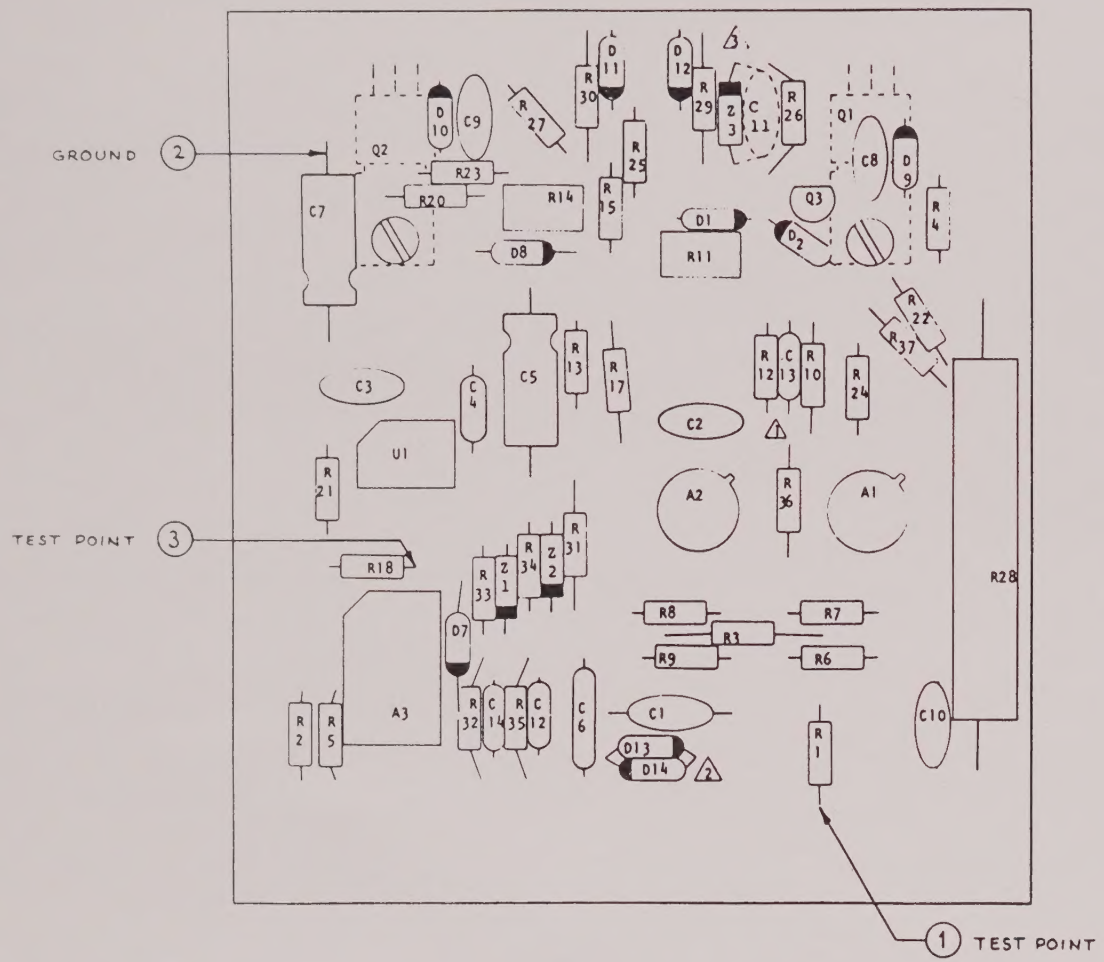
REV

SCARAB GRAPHICS NO. 83748



Behlman Engineering Corp SANTA BARBARA, CALIFORNIA	
DRAWN BY RK	APPROVED BY
DATE 10-26-83	SCHEMATIC: B-2024
TITLE POWER SUPPLY, REGULATED	
ASSY NO. 16-173	DRAWING NO. B-2025 SHEET 1 OF 2 REV
16-149	
NEXT ASSY / USED ON	
APPLICATION	

BCARAB GRAPHICS NO 83748

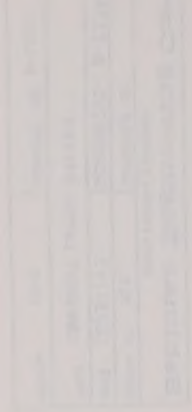


NOTE:

1. C13 AND R36 USED AS REQUIRED.
2. D13 AND D14 MAY BE REPLACED WITH JUMPER AS REQUIRED.
3. C11 USED AS REQUIRED. INSTALLED ON CIRCUIT SIDE.

Behlman Engineering Corp SANTA BARBARA, CALIFORNIA	
DRAWN BY PLK	APPROVED BY
DATE 10/31/83	SCHEMATIC: B-1274/A
TITLE COMPONENT LAYOUT, DRIVER	
MODEL DR-9	DRAWING NO B-2103

BISHOP GRAPHICS/ACCUPRESS
RECORD # NO. A11215



MP MASTER
MA29411